MANUFACTURING AND PRODUCIBILITY TECHNOLOGY

CO-CHAIRMEN:

JAMES D. HANKINS - NASA/MSFC
ROBERT L. DRESHFIELD-NASA/LeRC

Overview:

Manufacturing/Producibility is one of ten Working Groups within the Advanced High-Pressure O_2/H_2 Technology Program. The objectives of the M/P Working Group are:

> "To develop and evaluate process and manufacturing techniques for advanced propulsion hardware design and selected materials. To optimize the producibility of SSME components and assemblies by improved performance, increased life, greater reliability, and/or reduced cost."

The M/P Working Group activities are guided by a committee which has LeRC and MSFC membership representing a broad spectrum of organizations, disciplines, and technology users. The committee is co-chaired by LeRC and MSFC personnel, and includes the following members.

Co-Chairmen:		
J. D. Hankins	MSFC	Materials/Processes
R. L. Dreshfield	LeRC	Materials

Members:

O. K. Goetz	MSFC/EE51	Engine Development
R. P. Grimes	MSFC/EP23	Combustion Devices
T. D. McCay	MSFC/EP23	Turbomachinery
H. L. Goldstein	MSFC/EP23	Instrumentation
J. E. Gattis	MSFC/EF12	Controller
T. D. Byrd	MSFC/EP33	Valves & Actuators
R. R. Holmes	MSFC/EH43	Materials/ Processes
L. D. Salter	MSFC/EP46	Stress
R. G. Zagrodzky	MSFC/EG03	Quality Assurance
M. A. Bryant	MSFC/SA55	SSME Profect Office

Twelve work elements within the M/P Working Group have been identified. Six are active at MSFC or LeRC, as briefly described and noted in the following list. A seventh, Laser Welding, is proposed for a FY 85 start, and the initiation of the balance (5) will be FY 86, or later.

MANUFACTURING/PRODUCIBILITY

L1. VACUUM PLASMA COATING PROCESSES:
MSFC ACTIVE
To provide thermal shock resistant coatings and application process which will extend the service life of SSME components(blades, discs, heat shields, etc.) through vacuum plasma spray techniques, and subsequent application of these techniques to other space hardware.

L2. ADVANCED WELDING DEVELOPMENT:
MSFC ACTIVE
To assess the potentials of the plasma

arc and variable polarity plasma process on Inconel 718 and Incoloy 903. In particular, points to be investigated are: Number of weld passes, porosity, distortion, microfissuring, crater cracks, and equipment reliability.

L3. COMBUSTION CHAMBER WALL COATINGS:
LeRC ACTIVE
To develop technology for applying thermal barrier ceramic coatings to high-pressure rocket engines' metallic substrates, develop analytical models for predicting coating failure limits and thermal conductance, and determine appropriate mechanical and thermal properties of the coating system.

L5. HIGH-PERFORMANCE ALLOY ELECTROFORMING:
MSFC ACTIVE
To develop a system for electroforming materials with high-strength and high-temperature mechanical properties which can be used for fabricating advanced engine components. The use of such a system would have the potential for improving the life expectancy and reliability of engine components as well as weight reduction and simpler fabrication procedures.

L7. CERAMIC TURBINE ELEMENTS:
MSFC ACTIVE
To develop technology for manufacturing and utilizing high-strength turbine components that will improve the efficiency of operation of turbines by operating at higher temperatures than metallic elements.

L14. ADVANCED TURBINE BLADE COATINGS:
LeRC ACTIVE
Provide performance studies of various

thermal shock resistant/thermal barrier coatings relative to thickness, protective capability, strain tolerance, alternative disposition techniques and verification via hot gas rig testing.

L11. LASER WELDING:
MSFC FY85
To develop and demonstrate laser welding and capability for fabrication via fusion joining SSME-type materials and joint configurations.

L9. NOZZLE TUBE FABRICATION FROM NEW MATERIAL:
MSFC FUTURE
Candidate alloys will be characterized for application as nozzle tubes for an uprated SSME. One alloy will be selected for processing through a complete development phase and producibility study.

L13. SUPERPLASTIC FORMING/DIFFUSION BONDING TECH:
MSFC FUTURE
Superplastic forming and diffusion bonding technology will be exploited for nickel base alloys. It is expected that implementation of this technology would substantially reduce costs and improve SSME component performance.

L15. CERAMIC MATERIALS EVALUATION:
LeRC FUTURE
Evaluate silicon carbide/silicon nitride family of materials for application to high-temperature LOX/LH_2 engine components relative to failure modes and microstructures.

L16. INERTIA WELDING:
MSFC FUTURE
To develop inertia welding technology and

parameters for increased reliability and producibility of LOX posts in current and future SSME combustion devices.

L17. ADVANCED PROCESS CONTROL TECHNOLOGY:
MSFC FUTURE
To assess the application of weld-sensing techniques for advanced manufacturing processes, determine deficiencies that require improved or new technology, and update sensor technology for producing lower cost or higher quality O_2/H_2 engines with closed loop, computer controlled processes.

Three of the above active M/P Elements (L1, L3, and L7) were selected as topics for papers in this technology conference.

"Rocket Thrust Chamber Thermal Barrier Coatings," by R. J. Quentmeyer, LeRC/NASA

"Ceramics for Advanced O_2/H_2 Applications," by H. Carpenter, Rocketdyne Division, Rockwell International

"Vacuum Plasma Coatings for Turbine Blades," by R. Holmes, Materials and Processes Laboratory, MSFC/NASA